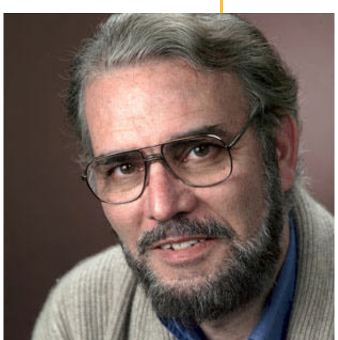
PI-in-a-Box

by Dr. Silvano Colombano

The PI Comes Calling

Projects often have many goals. Some are stated explicitly, some aren't. You would like for all the goals to be in alignment right from the start, but sometimes it takes time for the different customers to work together to make that happen.

An Artificial Intelligence (AI) project I managed from 1986 through '93 typified this kind of situation. The name we chose for the project was PI-in-a-Box, as our task was basically to put the Principal Investigator's brain in a laptop computer, figuratively speaking of course, and send it into space. That name was deemed "too cute" by some at Headquarters, so ASA (Astronaut Science Advisor) was used officially until the flight. PI-in-a-Box however continued to be used as the nickname, and was re-established as the official project name after my departure.



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works in the Computational Sciences Division at NASA's Ames Research Center, where he leads a group in "Evolutionary Biotronics." Projects cover Evolutionary Hardware, Modular Cooperative Robotics, and Artificial Life. Dr. Colombano has spent most of his working career at Ames, first, as a researcher in Closed Ecological Life Support Systems (CELSS) and, later, in Artificial Intelligence. He received an M.A. in Physics and a Ph.D. in Biophysical Sciences from the State University of New York at Buffalo. He began the development work on the Astronaut Science Advisor (a.k.a. PI-in-a-box) and managed the project until its deployment on SLS-2 (Space Shuttle STS -58) in 1993.

Officially, the goal of the project was to improve the scientific return of experiments by providing the astronaut-experimenters with direct feedback while conducting their experiments. An "intelligent assistant," the software in the box, tried to encapsulate as much as possible the relevant domain knowledge commanded by the PI on the ground.

PI-in-a-Box was intended to offer some flexibility in the experiment's protocol by way of a set of instructions delivered over a laptop computer screen as they were doing the experiment. The astronaut-experimenters were physicians and life-science professionals, but they were not scientists in the particular area of this experiment. You couldn't expect them to change the protocol on the spot if something unexpected occurred.

Goals

The official goal of the project was understood by everyone very clearly. "Unofficial goals" were also clear to those of us involved in the project. For my team, the unofficial goal was to show that NASA's recent investment in AI was worthwhile and that we could help. As we were a relatively new division at NASA, we were delighted to be on a high profile mission—it would be the first intelligent assistant, or expert system, used in space—and if the project went well, we knew it would certainly be a big boost in our status.

For the payload integration group we were working with at Johnson Space Center (JSC), their goal was to facilitate a safe and successful mission in the manner they knew how to do. Some of the folks in charge of figuring out how this and the other experiments were done on board the spacecraft were far less enamored of AI than I was. I could understand their point of view. I was asking them to do new things that they hadn't planned on. The experiment itself, designed to test how humans transfer visual cues to inner cues, was going to take place on the mission regardless of whether our PI-in-a-Box made it on board. With this new "unknown" added into the equation, there was one more factor that could go wrong.

I had to do a considerable amount of work to convince them that it would be really helpful to the astronauts to have this "intelligent assistant" on board. To their credit, they listened to me and told me exactly what I needed to do to ensure the system would work as promised. However, we had to jump through countless numbers of hoops to convince them that the system wouldn't cause any problems in space. At times it seemed impossible for us to meet all their requirements. Frequent communication was important in developing a good working relationship, but adaptation was even more critical.

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Then there were the astronauts. They were tough customers too, as well they should be. One of the things the experiment was trying to answer was why we get sick in space and ultimately how to remedy that. The astronauts would look into a rotating drum painted with colored dots and, as the dots rotated, they would feel themselves rotate too – and (sometimes, unfortunately) get sick.

There was a lot of stuff going on at once, and that meant plenty of opportunities for something to screw up. This was just one of many experiments they were going to do on the mission, and one of many PIs they were working with. Given the nature of our experiment, you can imagine it was one they would not miss if it never occurred.

The astronauts helped us in building a better system by teaching us how to understand their needs. Again, it was communication and adaptation. In a software project sometimes, a developer thinks that the user is going to need this or want that, and then it turns out that the user in fact couldn't care less. With astronauts, because their time is so valuable, the user interface must always be on your mind. It was a good lesson for us to try and understand what was important to them, which sometimes meant compromising on the loftier AI goals.

Coping with Expectations

Lest we forget too quickly, it is worth reiterating that this project was not merely about conducting a scientific experiment; it was also an experiment in how an experiment in space could be conducted. The parties involved knew they were part of something original and far ahead of its time, and we could all take pride in our accomplishment. Indeed there is nothing that brings people together like success.

When at last the mission flew, not all parts of the system were exercised. The diagnostic capability, while important, wasn't used simply because, luckily, the experimental equipment performed flawlessly. Interestingly, this success was viewed as a shortcoming by people who sought to justify this technology mainly because of its diagnostic capabilities. Again, goals and expectations need to be tailored to the limitation inherent in "one shot" space technology experiments.

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Interpretations for success were based on expectations. Some called the project only a partial success because the diagnostic capability wasn't deployed. To my team's way of thinking, it was a tremendous success. The important point is that we had succeeded in achieving the goal of helping astronauts conduct a difficult experiment in space and obtain the best possible data in the allotted time.

PI-in-a-Box enjoys the distinction of being the first expert system used in space. My involvement ended there. By then I was ready to move on. I had devoted seven years to this project. A later version of PI-in-a-Box was adapted to a sleep experiment and flown again on "Neurolab" in 1998.

LESSONS LEARNED

Projects often have many goals. Some are stated explicitly, some aren't. You would like for all the goals to be in alignment right from the start, but sometimes it takes time and for the different customers to work together to make that happen.

Your role on a project is to be aware of and sensitive to and adapt to the different needs of the customers throughout the life of the project.

QUESTION

This story calls our attention to two diverging views on project objectives. In one view the objectives are well defined and the parties are able to align them very early on. In the second view, the objectives compete with one another and remain in flux until the end. On your projects, which view are you closer to?